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A. Ian Hamilton

President's Message

Dr. Hamilton *was born and raised in Winnipeg, Canada and received his D.D.S. degree with Honors from the University of Toronto. Following graduation, he practiced dentistry in Winnipeg and Victoria for a number of years, and also served on active duty with the Canadian Dental Corps for approximately five years. He then joined the staff of the Department of Operative Dentistry at the University of Washington in 1949, and subsequently received B.A. and M.A. degrees in economics from that university. In 1968 he was awarded a Ph.D. degree in anatomy from the University of London. He is presently Professor in the Department of Restorative Dentistry at the University of Washington. Dr. Hamilton holds memberships in many significant professional organizations, and is a Fellow of the American College of Dentists.*

As I begin my term of office as president of the Academy I should like at once to express my sincere gratitude for this great honor that has been accorded me. Needless to say, during the forthcoming year I shall strive virgorously to pursue the worthy objectives of our great Academy.

To Bill Ferguson, our outgoing president, I offer my personal thanks and the sincere gratitude of the membership for the consummate skill and exceptional foresight with which he has conducted the Academy affairs over the past year. At all times and in every way — with an enviable flair for impeccable public relations — he has labored diligently to promote the objectives to which we are dedicated. I hope that as immediate past president he will continue his splendid efforts to help us advance the cause of good dentistry — a cause, I know, to which he is devoted. Undoubtedly the newly established Academy of Operative Dentistry, of which Bill has been elected the first president, will provide a timely outlet for his creative talents. I wish you good luck in your new appointment, Bill. The Academy of Operative Dentistry is indeed fortunate, during the critical days of its early development, to have you as its leader. I wish you great success with your new assignment and look forward confidently to cordial relations and fruitful cooperation between the two Academies in the years ahead. With two organizations pursuing similar aims, though from slightly different points of departure, the effectiveness of the combined efforts should be substantial.

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It is always a disappointment — and sometimes a disaster — that the quality of much of the dental treatment we see is so low compared with the quality we know is possible today. It is doubly discouraging when we contemplate the immense effort the Academy has put forth to encourage improvement in the quality of dental service. Do we see, as a matter of course, restorations with smoothly finished margins and highly polished surfaces? Do we see tooth form properly restored and designed so as to maintain the supporting tissues in a state of health? Do we see compacted gold as the agent of choice in the treatment of those initial lesions for which it is so eminently suitable? Do we see these features — which scientific evidence shows to be beneficial? No, unfortunately, all too often we do not. Perhaps in these days of heightened interest in consumer protection and consumer education — too long delayed — we should do more to acquaint the consumer with the advantages of compacted gold as a mode of treatment. Consumer pressure is a force to be reckoned with and perhaps before long we will see news reports telling us that so many thousand patients have had to be recalled for correction of defective treatment. Be that as it may, we should not overlook any method that might help us in our endeavor to promote excellence in dental service.

Geographic disparity in the extent to which compacted gold is used as a therapeutic agent, when no comparable disparity exists in the dental needs of the populations of the various regions, is a worrisome fact. The salutary effects of the study club movement in promoting and sustaining an interest in providing compacted gold restorations are well known and the formation of new study clubs should proceed apace. The difficulty of beginning such a study group where none has previously existed is recognized, but mere difficulty should not deter us. The established study clubs, with their practical knowledge and expertise, stand ready at all times to offer assistance in forming new clubs. Perhaps the time has come for those of us who practice in localities not well endowed with study clubs to launch a massive drive to interest our colleagues in study club activity. We have no time to lose, for it will not have escaped your notice that in many instances our dental schools — the very institutions charged with scientific leadership — are reducing the time and effort allocated to instruction in the use of compacted gold.

Let us renew our efforts to promote the use of the best material that has been developed so far for restoring teeth; for as the beneficial effects of fluoridation and plaque control become increasingly manifest, the carious lesions we have to treat are likely to be smaller than in the past and thus more suitable for compacted gold. Our patients deserve this service; we are obliged to provide it.

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M.H. Reisbick, D.M.D.,M.S.
F.A. Xhonga, D.D.S.

The validity of laboratory testing for predicting clinical behavior of the direct gold restoration, part I†

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Introduction

Laboratory investigations of the physical properties of direct filling golds have been frequent, and include the transverse bend test,[1] Knoop hardness,[2] density,[1] microleakage,[3] tensile strength,[4] and microstructural examination.[5] The relevance of these laboratory tests in predicting the clinical behavior of direct filling golds is obscure.

The appearance of porosity in a direct gold restoration is of concern to the clinician. This porosity, which appears after the restoration is in service, is thought to be related to the length of time the restoration has been exposed to the oral environment. Presumably, the hardness of the finished surface is related to its abrasion resistance and, therefore, perhaps to its ability to maintain integrity with time.

During placement of a direct gold restoration, emphasis is given to condensing and burnishing in order to achieve maximum hardness. However, when the finishing procedure includes the removal of excess material, the hardened superficial layer may be eliminated. This could be responsible for pitting and porosity, which may be seen after the restoration has been in service.

The purpose of this two-part study was to investigate the effect of surface hardness on the longevity of the direct gold restoration. Part I, which is reported here, is a laboratory investigation. Part II, which is being undertaken, is primarily a clinical study.

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Dr. Xhonga *is assistant professor, Section of Operative Dentistry, School of Dentistry, UCLA, Los Angeles, California.*

†*These data were presented in part at the February, 1971 meeting of the American Academy of Gold Foil Operators, Great Lakes, Illinois.*

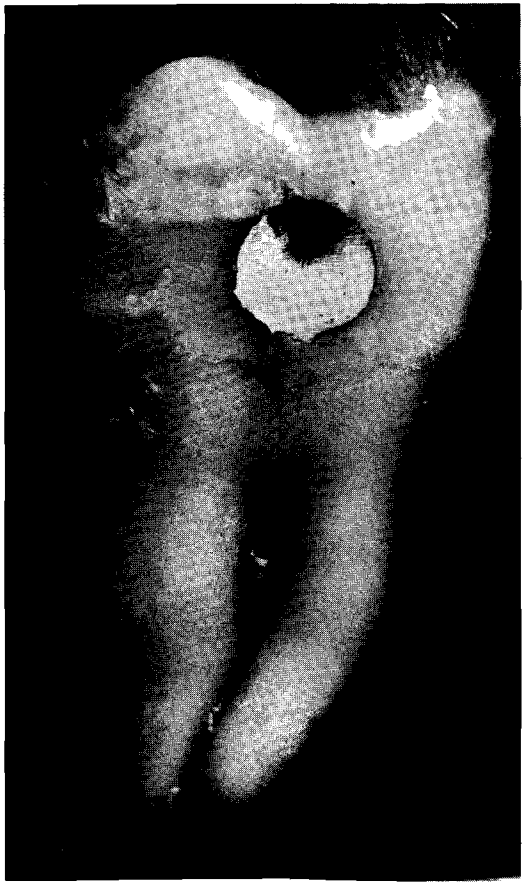

Fig. 1 — *Uniform Cavity Preparation Made into Freshly Extracted Tooth*

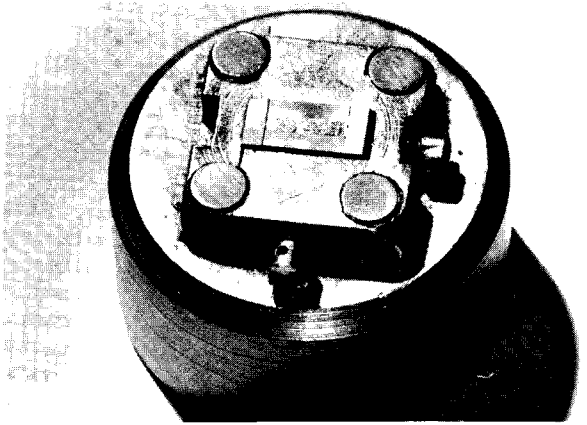

Fig. 2 — *Steel Mold Used for Preparing Transverse Samples.*

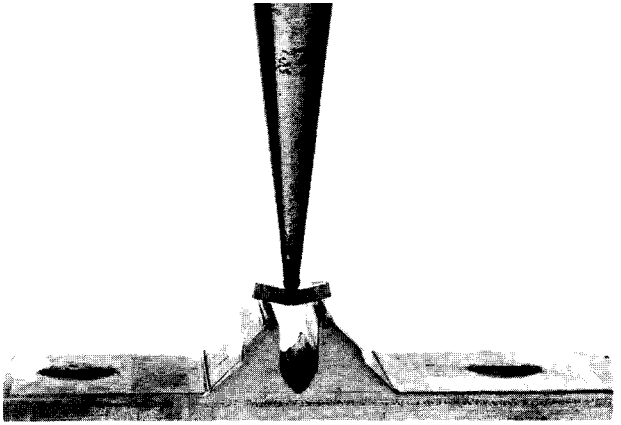

Fig. 3 – *Close-up of Specimen Being Fractured in Three-Point Bending.*

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Selected direct filling golds are examined in Part I. Electraloy, R.V.*, an alloy of gold and calcium, was examined because of its increased hardness, as determined subjectively by clinical use. This increased hardness over that of other direct filling golds used was recently substantiated objectively by laboratory procedures.[5]

Furthermore, investigations were designed to reveal other selected physical properties of Electraloy and to compare these with similar properties of two popular direct filling golds. Special attention was focused upon the property of hardness at selected depths.

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Materials and Methods

Three materials were selected for testing: Gold Foil,** Goldent** and Electraloy.* The tests examine transverse strength, density, marginal seal and micro-hardness.

All samples were condensed into a 1.5 mm X 1.5 mm X 7.5 mm steel mold or into prepared cavities in extracted natural teeth (Figures 1 and 2). The gold increments were individually annealed over an open flame and condensed with the McShirley*** electro-mallet to provide standardization. All specimens were over-filled and the excess was removed with a gold knife. This relatively smooth surface was then burnished. The time for condensation and finishing of each sample was recorded.

Density: The density of each sample obtained from the 1.5 mm X 1.5 mm X 7.5 mm mold was determined by measuring its dimensions with a micrometer followed by weighing on a Mettler balance. As alluded to by Phillips,[6] this is apparent density and not true density.

Transverse Bend Test: After density determinations, the compacted samples were fractured in an Instron testing machine at a load rate of 0.05 inch per minute. The sample rested on two parallel supports, 0.03 inch in diameter, and separated by 0.196 inch. Load was applied through a 1/16 inch steel ball which was positioned in the center of the burnished surface (Figure 3). Ten samples of each gold were tested. Transverse strength was determined by using the following formula:

$$S_T = \frac{3\,LP}{2bh^2}$$

L = distance between support rods; P = fractured load; b = width of the specimen; and h = thickness of specimen.

Hardness: The fractured samples utilized for the transverse strength test were also used for the hardness test. The samples were embedded and Knoop hardness numbers were determined from micro-indentations made into the burnished surface and the pulpal surface. In addition, hardness of the level

*Williams Gold Refining Co., 2978 Main St., Buffalo, New York
**Morgan, Hastings and Co., 1321 North Front Street, Philadelphia, Pennsylvania
***McShirley Products, 6535 San Fernando Rd., Glendale, California

Fig. 4 – *Sectioned Tooth Showing Penetration of Dye Beyond Pupal Wall.*

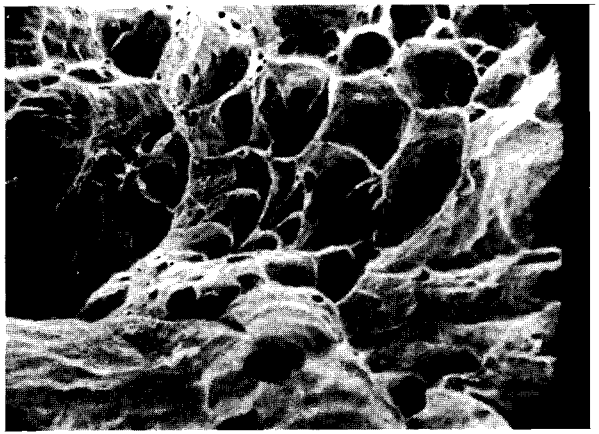

Fig. 5 – *Section Showing Fracture Through Gold Foil Specimen (2300X).*

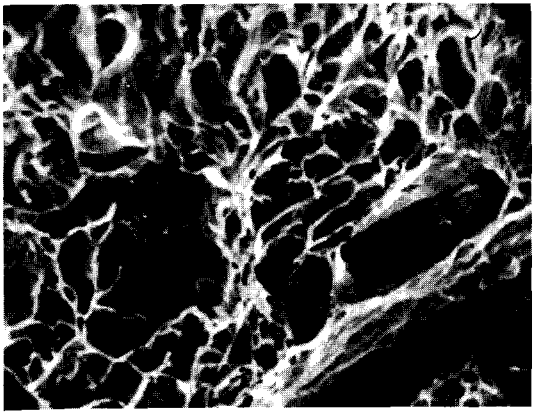

Fig. 6 – *Section Showing Transverse Fracture Through Electraloy RV Specimen (2300X).*

Fig. 7 – *Section Showing Transverse Fracture Through Goldent Specimen (2300X).*

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produced by removing 0.001 inch from the burnished surface using a carbide bit in a milling machine was determined. Ten specimens, at three levels, were evaluated for the materials being investigated.

Micro-leakage: Uniform cavity preparations were made into freshly extracted human teeth by using a No. 468 diamond cutting instrument which was mounted in a porcelain facing drill.* The depth of each cavity was 2 mm and the width was 3 mm. Retention was placed with a ¼ round carbon steel bur. Ten samples were prepared for each gold type and condensation and burnishing were carried out as previously described. After finishing, the "restored" teeth were removed from the acrylic blocks and wax, used as a sealant, was applied around the tooth, except for the restoration and its margins. The teeth were then immersed in a fluorescent penetrant for one hour, after which they were washed and scrubbed, and then dried for two hours. By sectioning the teeth labio-lingually with a carborundum disk, the gold restoration could be removed in one piece, and the extent of penetration recorded using 30X magnification under ultra-violet light (Figure 4). A scoring system of zero to four was adopted for quantitating the extent of penetration: 1 = penetration into the enamel only; 2 = penetration into the dentin, but not to include the base of the cavity; 3 = penetration including the base of the pulpal wall; and 4 = penetration into the pulp chamber.

Results and Discussions

The data for density, transverse strength and micro-hardness were analyzed by using the Analysis of Variance,[7] while the data for microleakage were interpreted using the Chi Square method.[8] All results are reported at the 0.95 confidence level.**

1. There were no statistical differences between the apparent densities of Gold Foil, Goldent, and Electraloy, as evidenced by the Analysis of Variance. These values (Table I) are somewhat higher than those reported by Richter and Cantwell.[1] Longer condensation times and different sample geometry

TABLE I: *The Apparent Densities of Gold Foil, Goldent, and Electraloy.*

	Density (g./c.c.)	
Material	*Mean*	*Stand. Dev.*
Gold Foil	*18.2*	*1.3*
Goldent	*17.8*	*0.6*
Electraloy	*17.7*	*0.4*

*Mardelle Ind. Prod., Model MD-11, Monrovia, California

**Computing assistance was obtained from the Health Science computing Facility, UCLA, sponsored by NIH Special Resources Grant RR-3.

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might account for these differences. The experimental values, however, fall within other previously reported values.

2. There were no statistical differences between the transverse strengths of the materials investigated. This is not in exact agreement with the previously reported study, but again could be explained by sample geometry. Figures 5, 6 and 7 show typical fractured surfaces of the three types of material. Figures 1 and 4 display excellent welding while Figure 7 shows more of a mechanical interlocking. Gold Foil and Electraloy show microstructures typical of ductile fracture.

3. A summary of the hardness data for the three types of direct filling golds is shown in Table II. The pulpal floors showed significantly less values

TABLE II: *Hardness data for Goldent, Electraloy, and Gold Foil.*

	Goldent	Electraloy	Gold Foil	Mean
Pulpal Floor	68.78	80.30	71.87	73.65
Burnished Surface	86.13	97.65	89.22	91.00
0.001 Inch Removed	76.68	86.20	77.77	79.55
MEAN	76.53	88.05	79.62	81.40

than those for the burnished surface in all cases. When a layer of approximately 0.001 inch was removed from the burnished surface, the Knoop values decreased significantly (an average of 12%). The Analysis of Variance showed significant differences between materials with Electraloy exhibiting the highest hardness.

4. Table III exhibits the fluorescent dye penetration for the three direct gold restorative materials. Most of the samples fall into the slight and moderate

TABLE III: *Florescent dye penetration for Gold Foil, Goldent and Electraloy.*

		Penetrations					
Material	Number of Samples	0 No	1 Slight	2 Moderate	3 Severe	4 Extreme	Mean
Gold Foil	10	—	4	5	1	—	1.7
Goldent	10	—	4	4	1	1	1.9
Electraloy	10	1	7	2	—	—	1.1
TOTAL	30	1	15	11	2	1	

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penetration group. When the data were analyzed by Chi Square test, no significant differences between materials were detected.

Conclusions

This study indicates that Electraloy is at least comparable to other existing direct filling golds regarding transverse strength, density, micro-hardness and micro-leakage. Because of its increased hardness, Electraloy, if burnished, could possibly provide a less porous surface which might retain its surface finish longer while in service. Clinical studies investigating this possibility are now underway.

Acknowledgement

The authors would like to thank the following students for their technical assistance: Messrs. T. Protopappas, M. Paye, and J. Brodsky.

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Gregory E. Smith, D.D.S., M.S.Den.
Jean T. Hodson, B.S., M.S.
Gerald D. Stibbs, B.S., D.M.D.

A study of the compaction of Pure Gold into retention holes, convenience points and point angles in class III cavity preparations

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Various designs are advocated in cavity preparations for Class III restorations of pure gold. One design that is widely recognized was refined by Ferrier[1]. It is characterized by sharp internal line angles for resistance form during insertion of the gold and by sharp internal point angles for convenience in starting the gold at the labio-axiogingival and linguo-axiogingival point angles. This basic form is highly satisfactory, but some operators[2 3] prefer added convenience in the form of a pit in the labio-axiogingival and/or linguo-axiogingival point angles. Such convenience pits facilitate starting the compaction of the gold. Although larger holes are advocated by some[4 7] for retention of the finished restoration, a long history of success with the Ferrier design has shown that large holes are not necessary for retention, and, furthermore, such holes may undermine the enamel or encroach needlessly upon the pulp.

A study was made to determine the size of the smallest pit in clinical use into which gold could be densely compacted, since Jeffery[2] and Stibbs[3] have recommended that small pits, approximately 0.42 mm in diameter, are adequate to serve as convenience points for receiving the initial pellets of pure gold to which the remainder of the restoration is added.

Dr. Smith *is a native of Seattle, Washington. He received his D.D.S. degree from the University of Washington in Seattle in 1965 and his M.S.D. in 1971. He serves on the University of Washington faculty as an instructor in the Department of Restorative Dentistry and is an active member of the George Ellsperman Gold Foil Seminar. Professor Hodson is also a member of the faculty of the Department of Restorative Dentistry. Dr. Stibbs, professor of operative dentistry and fixed partial dentures, former chairman of the Department of Operative Dentistry, is special assistant to the dean of the School of Dentistry at the University of Washington.*

Materials and Methods

Convenience pits were prepared in 24 extracted, dried, human teeth which were cleaned and trimmed to remove most of the enamel. The roots were squared to create flat surfaces for mounting in the bench vice. Triangular preparations were cut* in the dentin on one side of the tooth with a 33½ inverted-cone, carbide bur. The internal line angles were finished with a 6½-2½-9 hoe and with 7-(84)-2½-9 right and left angle formers. The finished cavity preparation had three walls which met to form an acute point angle. It was at this location that the point angle was accentuated with a retentive hole or convenience pit. Retentive holes were cut with the 3/0 round bur (0.75 mm diameter) and the 27 gauge twist drill (0.7 mm diameter) to a depth of 0.9 to 1.8 mm. The convenience pits were cut with the 4/0 (0.4 mm) end-cutting inverted-cone bur to a depth of 0.4 to 1.4 mm. The Ferrier cavity was used without pits or holes to demonstrate compaction density at a point angle.

Two forms of pure gold were used. Size 1/128th and 1/64th pellets were rolled from a sheet of Number 4 gold foil** and compacted with hand malleting in 21 specimens[8 9]. Mat gold*** was cut into triangular pieces measuring 2 mm on each side, placed over the retentive holes with hand pressure, and then covered with foil pellets compacted with hand malleting in three specimens.

A 0.5 mm condenser was used to compact the 0.7 and 0.75 mm diameter retention hole specimens and one group of the 0.42 mm pit specimens. The remaining specimens were compacted with the 0.4 mm condenser. All specimens were compacted with hand malleting.

After compaction, the specimens were trimmed to remove excess tooth structure and embedded with epoxy resin in acrylic blocks. They were sectioned vertically and then ground on abrasive papers through No. 4/0 and polished on nylon cloth with wet alumina for microscopic study with the metallograph.**** Representative specimens were photographed as polished. Metallurgical etching was not performed in this study because the walls of the preparations would have been lost due to the solubility of dentin in gold etchants.

Results

The porosity observed in the gold was used as a basis for comparison of the efficiency of compaction. Void spaces occurred in the folds of single pellets and between unwelded pellets.

The specimens were divided into six groups according to the diameters of the bur and condenser (Table I). The first group had no pit or hole

* *Air Turbine, Midwest American, Melrose Park, Illinois.*
** *Morgan, Hastings & Co., Philadelphia, Pa.*
*** *Williams Gold Refining Co., Buffalo, N.Y.*
**** *Me F. C. Reichert, Vienna, Austria.*

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placed. The cavities were filled with 1/64th pellets and compacted with the 0.4 mm condenser. These specimens (1 through 3, Table I) demonstrated dense and well compacted gold foil. Voids were present in all specimens, but they were smaller, shallower, and fewer in number per unit area in these point angles than the voids in the specimens with pits or holes (Fig. 1).

TABLE 1: *Compaction Results.*

Specimen No.	Bur Dia. (mm)	Condenser Dia. (mm)	Hole Depth (mm)	Void Distribution: Pit Bottom 1/3	Pit Middle 1/3	Pit Top 1/3	Angle	Pellet Size	Pellet No. * *
1	none	0.4	N.A.*	N.A.	N.A.	N.A.	+	1/64	0
2	"	"	"	"	"	"	+	"	0
3	"	"	"	"	"	"	+	"	0
4	0.4*	0.5	1.4	0	0	—	N.A.	"	2
5	"	"	0.5	0	+	+	"	"	1
6	"	"	0.9	0	0	—	"	"	1
7	"	"	1.4	0	—	—	"	"	2
8	"	0.4	0.7	—	+	+	N.A.	"	1
9	"	"	0.5	—	+	+	"	"	1
10	"	"	0.8	0	0	0	"	"	1
11	"	"	0.4	—	+	+	"	"	1
12	"	"	0.5	—	+	+	"	"	1
13	"	"	1.3	—	+	+	N.A.	1/128	2
14	"	"	0.8	0	+	+	"	"	2
15	"	"	0.5	0	+	+	"	"	2
16	"	"	0.5	—	+	+	"	"	2
17	0.75**	0.5	1.4	—	—	—	N.A.	1/64	3
18	"	"	1.2	+	—	—	"	"	2
19	"	"	1.8	—	—	+	"	"	3
20	"	"	1.0	0	—	+	"	"	2
21	"	"	0.8	—	—	+	"	"	2
22	0.7***	"	1.5	—	—	—	N.A.	mat & 1/64	
23	"	"	0.9	—	—	—	"	"	"
24	"	"	1.8	0	—	—	"	"	"

+ Small voids, good compaction density
— Large and small voids, poor compaction density
O Complete absence of gold, lack of penetration
* End-cutting inverted cone
** 3/0
*** 27 gauge twist drill
⋆ Non-applicable
⋆ ⋆ Number of pellets in hole

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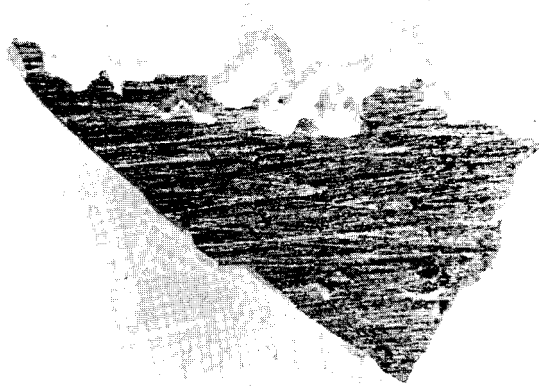

Fig. 1 – *Photomicrograph of gold foil compacted into a line angle in dentin of an extracted tooth; condenser serrations at the top surface, voids near the point angle at the bottom. Cross striations are artifacts resulting from specimen preparation. Porosity was minimal (Specimen No. 1).*

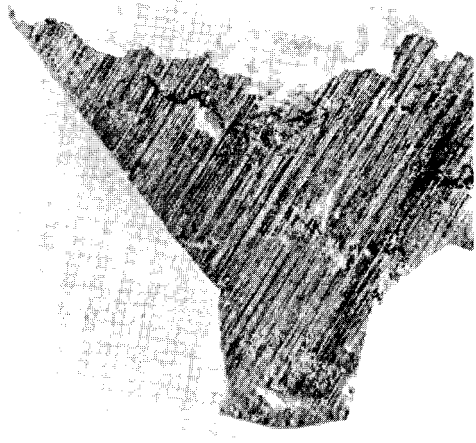

Fig. 2 – *Gold foil compacted into a convenience point prepared with the 4/0 (0.4 mm) end-cutting inverted-cone bur. Pit depth is 0.5 mm. Small voids, linear foil laminations, condenser imprints and polishing striations (Specimen No. 9).*

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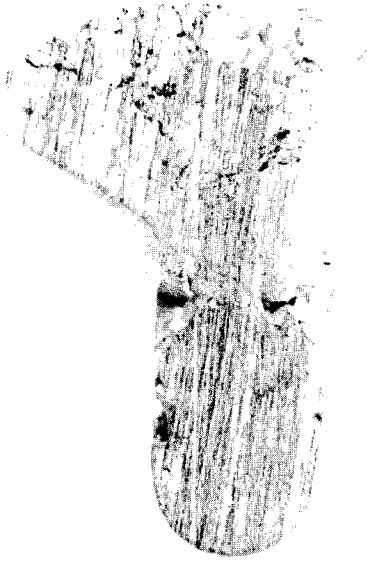

Fig. 3 – *Gold foil compacted into a retention hole prepared with 3/0 (0.75 mm) round bur. Hole depth in plane of section is 1.2 mm. Dense gold at depth of hole, large voids along the walls of hole towards opening into cavity, smaller voids in the center of the mass. Condenser imprints at top of photomicrograph (Specimen No. 18).*

Fig. 4 – *Mat gold and gold foil compacted into retention hole prepared with 27 gauge twist drill (0.7 mm). Hole depth is 0.9 mm. Uncompacted mat gold in depth of hole, porous gold foil above. Large voids present throughout the specimen. Small voids are present in the gold foil in the cavity above the hole (Specimen No. 23).*

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The specimens of the second group were prepared with the 0.4 mm diameter end-cutting inverted-cone bur. They were compacted with 1/64th gold foil pellets and the 0.5 mm diameter condenser point. These specimens (Nos. 4 through 7) demonstrated incomplete compaction of the gold foil into the pit. The gold had the appearance of having been placed in the pit with little or no compaction force. In none of these specimens was the foil found to be present at the bottom of the pit. This result was expected because the condenser nib was of larger diameter than the pit. The foil thus placed showed large voids throughout the mass in all except the shallowest specimen (No. 5). Two of the specimens (Nos. 4 and 6) showed that the foil penetrated into less than one-third the depth of the pit. Even the shallowest pit of 0.5 mm (Specimen No. 5) was not filled to its depth with the oversize condenser.

The specimens of the third group (Nos. 8 through 12) were prepared with the same 0.4 mm diameter inverted cone bur, filled with 1/64th size pellets, and compacted with the smaller 0.4 mm diameter condenser. In one specimen of this group (No. 10) the foil did not penetrate the pit. Those specimens in which the gold foil filled the pit were densely compacted, but voids were observed in the deeper portions of the pits and were present on the walls of the pits (Fig. 2). These specimens showed evidence of movement of the foil pellets at the opening of the pit into the cavity.

The specimens of the fourth group were prepared with the 0.4 mm diameter bur, and the 0.4 mm condenser, but were filled with the smaller 1/128th size pellets. The specimens (Nos. 13 through 16) showed compacted gold foil within the pits that was similar to the gold in the previous group. Although the foil did not fill all pits to their depth, there was evidence of dense packing in each specimen. Specimens differed in appearance from the previous group in that porosity was evident where the second 1/128th pellet failed to weld against the first pellet in the pit. Voids along the walls of the pits were similar to those in the specimens compacted with 1/64th pellets, but the gold was less porous around the opening of pits.

The specimens for the fifth group (Nos. 17 through 21) were prepared with the 0.75 mm diameter 3/0 round bur, the 0.5 mm diameter condenser, and 1/64th pellets of gold foil. Voids and uncompacted gold characterized these specimens. It appeared that the first and second pellets were not welded together as the foil was placed, and voids were observed also in the gold at the entrance to the hole. The foil penetrated to the depth of the hole with varying degrees of density. The gold was well compacted in the depth of the hole in one specimen (No. 18, Fig. 3) but was porous in three specimens at this level (Nos. 17, 19 and 21), and failed to reach the depth in another (No. 20).

The last group was prepared with the 0.7 mm diameter, 27 gauge, twist drill. Triangles of mat gold were loosely tucked into the retentive holes with hand instruments,[2] then overlayed with 1/64th gold foil pellets compacted with the 0.5 mm condenser. In these specimens (Nos. 22 through 24) there were large voids in the depth of the hole, and voids could be seen throughout the mass (Fig. 4).

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Conclusion

Conservation of tooth structure is desirable in dentistry[10], and adequate convenience and resistance form may be obtained in Class III cavity preparations from the placement of sharp internal line angles and acute point angles[11]. Small pits may be placed where necessary for additional convenience form. Large holes involve needless destruction of tooth structure and are incompletely filled. It may be concluded from this study that the 0.42 mm diameter pit was adequately filled with dense gold. It is difficult to produce a well-compacted, stable, mass of gold with 1/128th size pellets, and, therefore, the larger 1/64th size pellet is recommended for clinical use with the small convenience pit. A pit depth to 0.5 mm is sufficient to provide stabilization of the gold as compaction is begun. Additional convenience form is not gained with deeper pits, and tooth structure may be unnecessarily weakened.

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Norman C. Ferguson, D.M.D.

Fractured Cusps

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The frequency of cuspal fracture seems to be on the increase, probably resulting from factors such as trauma in automobile accidents and night-grinding habits due to modern stress. A more likely reason might be the tendency of patients to receive more dental care and to lose fewer teeth in early life.

In the normal young adult dentition one may expect to find a cuspid-protected occlusion. Since cusps on the posterior teeth function as spheres in contact, the movement from centric relation to an excursive bite must in effect lower the angle of posterior cusp rise. At the same time, because the upper cuspid is concave inciso-gingivally on the lingual surface, the cuspid rise must increase as the jaw moves laterally. If the upper cuspid is in contact with the lower teeth in centric relation, posterior separation must occur immediately the jaws leave this relation unless flexure of the temporomandibular joint allows contact to be maintained. Wear can only occur, then, in the posterior teeth in the areas that are in occlusion in centric position, i.e., the central fossae of all teeth, the buccal cusps of the lower teeth and the lingual cusps of the upper teeth.

At early middle age, the cuspid may have worn enough to expose dentin, with a sudden loss of cuspid rise. The posterior teeth will then maintain contact through wider excursive movements and lateral stresses will increase on the *unworn* cusps, the buccal cusps of the upper and the lingual cusps of the lower teeth. Undermining of the cusps by previous restorations will increase the incidence of cusp loss This occurs most frequently to the disto-lingual cusp of the lower first molar, followed by the buccal cusp of the upper first bicuspid.

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Presented at the AAGFO meeting, February 1971, Great Lakes, Illinois.

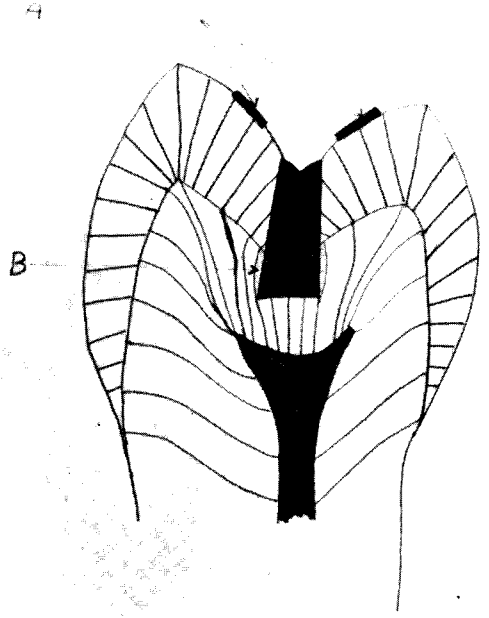

Fig. 1–*Conservative Preparation: A. Wear Areas Clear of Restoration; B. Small Amount of Undermined Dentine.*

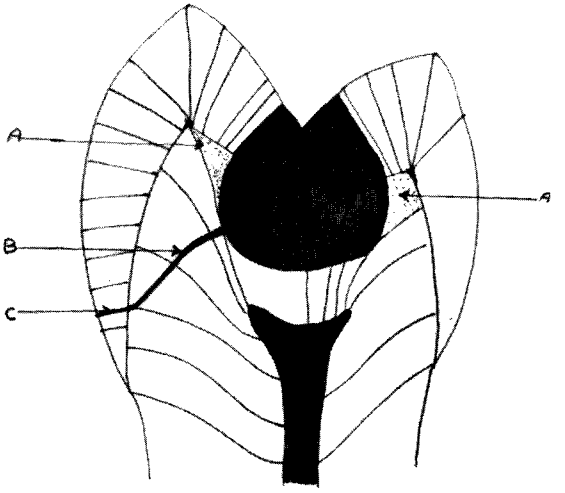

Fig. 2–*Excessive Tooth Destruction: A. Undermined Dentine; B. Fracture Line at Right Angle to Tubules; C. Fracture Line Parallel to Enamel Rods.*

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A full or three-quarter crown may be placed on the first tooth to show a fractured cusp. Such fractures may occur elsewhere and every attempt should be made to prevent them if possible. Equilibration of the occlusion, i.e., adding wear to the buccal cusps of the upper and the lingual cusps of the lower teeth will reduce the incidence of fractures through the restoration of the cuspid rise. Cuspal coverage with gold restorations may help, but a sacrifice of esthetics is usually involved. This is not recommended for teenage patients, as the average life expectancy of an inlay is not great enough to justify the sacrifice of esthetics and tooth structure at such an early age. Cusp coverage with porcelain in the posterior region of the mouth is even more hazardous. Wear may be prevented on the buccal cusp of a lower molar at the expense of the upper molar and cause a balancing interference in later life, the most destructive occlusal relation possible. To lessen the chance of fracture in later years, amalgam restorations in young people should be conservative, with narrow occlusal extensions, and very little proximal or occlusal retention (Figures 1 & 2).

An effective measure, in consultation with a periodontist, might be to restore the tip of the cuspid as soon as dentin is exposed and before any posterior fractures occur. This would continue the cuspid-protected form of occlusion into later life. Gold foil, or gold and plantinum foil, would seem to be the ideal restoration, forming a sacrificial pad that would not wear the opposing tooth but could be restored from time to time to compensate for wear as it occurred. Care to contour the labio-incisal edge of the restoration so as to reflect the light away from the eye of an observer should make this type of restoration in the upper cuspid virtually invisible.

This treatment, while innovative, is really very conservative. The amount of tooth structure removed to provide retention is very small and the procedure alleviates the necessity of equilibration of the posterior teeth at much greater sacrifice of normal tissue. Posterior wear is reduced, along with the risk of cusp fracture. One fractured cusp, and the tissue removal, concommitant with its repair, would sacrifice many times as much tooth structure. One must be aware of the increase of stress on the cuspid by the return to a cuspid-rise protected occlusion, but when there is wear on the cuspid, one can presume a good periodontal condition, otherwise the wear could not occur. Periodontally weakened teeth move away from occlusal stresses and do not show the wear of periodontally strong teeth.

If wear is even throughout the mouth, with no cusps weakened by restorations, the dentition may progress to show extreme wear, having an end-to-end bite, and a reversal of Monson's Curve, with worn and cupped cuspids offering very little cuspid rise. However, there is no balancing interference in the posterior segment because the buccal cusps of the lower teeth have been worn off as quickly as the cuspids. This condition has been described by d'Amico[1]. Interference with this wear pattern may reduce the comfort and health of the supporting tissues.

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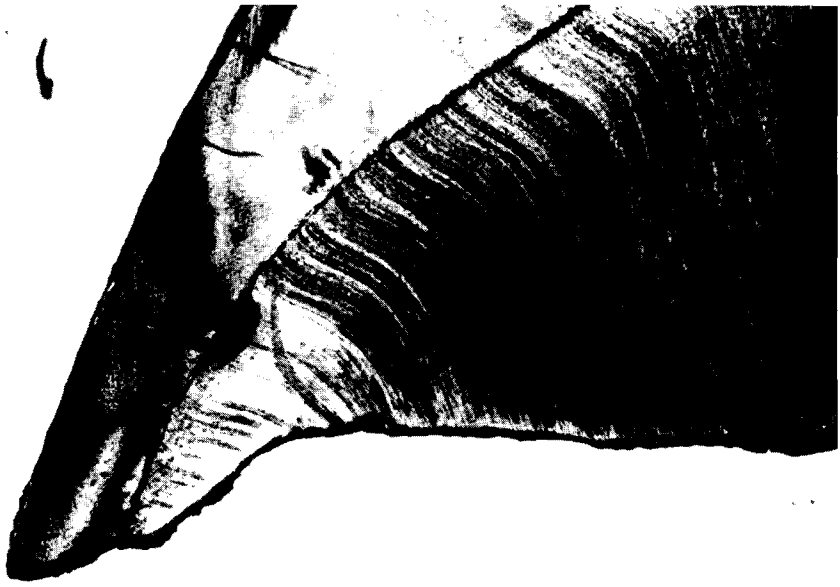

Fig. 3– *Fracture Line at Right Angle to Dentinal Tubules and Parallel to Enamel Rods.*

In a clinical series of one hundred fractured cusps, all were found to be broken from the pulpal line angle to the junction of the middle and gingival one-third surface of the crown. Without exception, the fractures occurred at *right angles* to the dentinal tubules, progressing to the dentino-enamel junction, where they turned to continue parallel to the enamel rods to the surface (Figure 3). No fracture involved the gingival one-third of the buccal surface where there was no buccal restoration present. Three cases of fractures of virgin teeth involved the pulp, while no fracture in a restored tooth involved the pulp. No fracture occurred at a bucco-gingival line angle, indicating that the ideal retention would be small and cut as much as possible at the expense of the gingival floor, and should have minimal occlusal extension along the axio-buccal or axio-gingival line angle (Fig. 4).

Early diagnosis of a fractured cusp is difficult. Commonly, the patient will complain of vague inconstant paints involving one quadrant. All teeth seem hypersensitive, especially to cold, and the pain occurs during any functional tooth contact. In contrast, high occlusion, as from a restoration, usually does not produce pain when a food bolus is present. Later, often after some months, the pain becomes more localized and one tooth becomes suspect. The dentist is well advised to test each cusp in turn by pressing outward from the central fossa of the tooth, by careful scanning of the area at the junctions of the gingival and middle thirds of the tooth for cracks and by transillumination. If a cusp breaks free, the pain usually subsides immediately. This fractured cusp syndrome is discussed by Sutton,[2] Cameron,[3] Ritchie,[4] and Stanley.[5]

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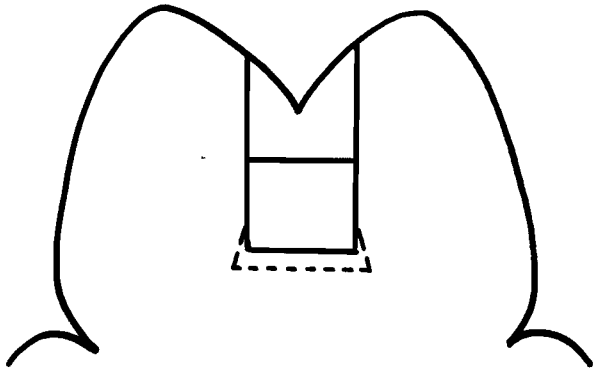

Fig. 4—*Conservative Preparation: Proximal Retention at Expense of Gingival Floor.*

Another cause of a similar vague pain may be due to anatomy cut too deeply on a large posterior restoration, such as a full crown on a lower first molar. As wear occurs, the large mesio-lingual cusp of the upper may extrude more deeply into the lower fossa, producing an effective rise in the inclination of the posterior cusps, and causing premature contact in working bite. A tell-tale sign is a polished facet on the occlusal surface of the lower first molar, extending up the mesial inner incline of the disto-lingual cusp. The same condition may occur as the result of wear of an amalgam restoration in the central fossa, or, more recently, through the promiscuous use of the plastic filling materials in the posterior teeth.

A very informative case occurred in which a seventeen year old boy was hit by a hockey stick, fracturing about three millimeters from the tip of his upper right cuspid. In the ensuing twelve years, he has lost, one at a time, four buccal upper and four lower lingual cusps on his right side. No cuspal fracture has yet occurred on his left side, which is protected by a well-defined cuspid rise.

It is the opinion of the author that many cusp fractures could be prevented by taking careful cognizance of occlusal relations and by early use of durable materials in conservative cavity preparations. The fact that an amalgam restoration may remain in a tooth for years after the fracture of an enclosing cusp would seem to indicate that much less retention was necessary in the original preparation. Too often dentin, the strong structural material of the tooth, is sacrificed to ease and speed of tooth preparation, then replaced with restorative materials of indifferent standards and characteristics. The chief modern offenders are the plastic-based composite products introduced as posterior restorative materials.

These materials so far exhibit high flow, i.e., low proportional limit, combined with setting shrinkage and a high thermal expansion. This is a very poor combination of properties for use in a stress-bearing restoration and excess retention is required in the cavity. In addition, while they may be abrasive because of their dispersed fillers, they are subject to abrasion because

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of their low matrix strength. Their color may encourage over-extension of the cavity in posterior teeth because the esthetic problem is reduced. A full discussion is available in the writing of Dr. G. M. Hollenback.[6] Gold foil remains our material of choice for small lesions of the posterior teeth.

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Hunter A. Brinker, Jr., D.D.S.

Gold foil—can we afford to do without it?

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October 8, 1971. Yes, we can say we are definitely in the space age. We are beginning the dawn of the age of Aquarius.

At no other time in our history have the people on Earth assembled greater scientific knowledge and technical skills. When you miss your computation for an accurate target splashdown by one second, and find the space vehicle off its target by 200 miles — this is tremendous speed. The space vehicle is going so fast, computers must aid the human mind. When you can thread a needle in space and land on the moon, ascend from the moon and thread a needle in space and return safely to earth, right on target — when a tiny television camera can send clear, beautiful pictures back to earth 238,855 miles away — when a supersonic jet transport can leave LaGuardia Field in New York City at 8 a.m. and land at International Airport in Los Angeles, California at 6 a.m., two hours earlier because of the time differential in traveling across the country — these accomplishments are evidence of tremendous technical ability coupled with vast and necessary scientific knowledge.

Medicine has also kept pace today.[1] Poliomyelitis has been conquered. Tissues can be typed and classified, similar to the blood being typed, guaranteeing that the recipient's tissues in a transplant will be matched with the proper donor's tissues. This has made kidney transplants highly successful. No longer do we have the rejection of the donor tissues as we used to. Dentistry, too, has answered today's challenges. We understand more clearly the role of the bacterial plaque in the etiology of caries and the periodontal lesion. We understand more fully the role of occlusion and how it can affect the health and harmony of the entire stomatognathic system. Today, we have autogenous

Dr. Brinker *is a member of many professional organizations and study clubs, chairman of the Florida State Board of Dentistry, consultant to the Office of the Surgeon General, Dental Corps, United States Army, and secretary of the American Academy of Gold Foil Operators.*

This paper was presented to the American Academy of Gold Foil Operators, October 8, 1971 at the University of Pennsylvania, School of Dental Medicine, Philadelphia, Pa.

tissue transplants and different types of implants. Better and more conservative restorative dentistry is accomplished through better access, good premedication, and a wide use of pins to aid in retention. Porcelain inlays can be fired in seconds — direct gold can be condensed in cavity preparations where the outline forms are inconspicuous. Longer lasting restorations and the utmost in esthetics are the result.

There is no place for mediocrity in the field of medicine and dentistry today. We should not be content with 1950 dentistry today . . . We should not be content with 1960 dentistry today . . . We should not be content with 1970 dentistry today . . . Today, we should do only 1971 dentistry; make use of proven research and apply it in our clinical practice. It is not right to change for change's sake, but if something has been proven through laboratory and clinical research to be a better service to our patients then it is not right to exclude this knowledge in our treatment plans.

In this age, students and people tell it the way they feel, not the way they think their Mom and Dad would like to hear them say it, or the way their professor or minister would like to hear them say it. They say it purely the way they feel it. This is a healthy attitude.

I want to discuss the therapeutic value of gold foil in private practice. How we do it, how we sell it, and how we make it pay for itself. "Tell it like it is." Is money important? I think most will agree — it is very important. I am in private practice, as are many other dentists. In a manner of speaking, we are all on the front lines, and any time you place your hands in someone else's pocketbook watch out — you are going to get shot at. Therefore, we must be conscious of the economic importance of evaluating any procedure or idea prior to utilizing it in our practice. We must concern ourselves with both money and economics. Any time I hear a lecturer talk about a certain subject, I can't help but relate it to the economic value of putting it into my practice. I ask myself, can I use it in my practice? Can I make it pay? Will the patients pay for it? If I can, I certainly use it, and if I can't, I store it aside for possible future use. Everything that appears in this article, I use in my practice. I make it pay, and I make it pay well.

A dentist must have many faces. He must be a salesman; he must be able to sell the patient on his philosophy of practice and on the treatment plan he wishes to use. He must have the knowledge to give an accurate diagnosis and then he must have the technical ability to carry out his treatment plan. Perhaps more important than all this, is one thing we often tend to forget. *We have to live with our patients.* For dental students, you will soon leave dental school; for those in the military service, you will eventually be transferred to another base. You are in one place for only a short time, and thus your patients are lost at this point. However, when you are in private practice, there is a good chance that you are going to live with these patients for the rest of your life. Your practice becomes inbred — you have friends of friends, families of families, and neighbors. You will see these people on street corners, in grocery stores, on the golf course, and at social events. If you have done work on these people that is not up to your ability, you have to live with it. If you do a jacket crown that does not fit or looks bad,

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you have to see that jacket crown year in and year out. Many times, it causes internal stress. This is not good. Not only do you have to live with this, but you have to live with yourself. We start out making up little lies and excuses and they can grow into big excuses and big problems. Consequently, we get into ruts and possibly come to hate dentistry.

It is important to start out right when you begin your practice. Strive for a goal of 100% in your diagnostic and technical abilities and keep seeking something even a little higher. A year ago, John Wooden spoke to the American Academy of Gold Foil Operators on his idea of success.[2] He called it his "pyramid of success," with various categories in this pyramid. His whole talk, however, centered around one point, and that was, "success is a peace of mind which is a direct result of self satisfaction in knowing you did your best to become the best that you are capable of becoming." Do your best to become the best that you can become. Whether it is in athletics, in your profession, or anything in life, shoot toward 100% or even 110%. We may have to settle for less, but that is much better than having a goal toward the middle of the road and have to settle for some failures. This is certainly not success.

I am going to tell you about the key to total treatment dentistry. To do 1971 dentistry, we must motivate patients. How do we motivate them? There are many ways. First, we must have a little time. Time to get to know our patients, and time for them to get to know us. We need time to motivate our patients to what we call their "unknown needs." How are we going to gain this time? One way is to establish a definite procedure which can usually be finished in a reasonably short period of time. Something that won't leave the patient coming back for further treatment, or leave him in a condition of temporization. An ideal restorative procedure to accomplish this end is the direct gold restoration. The patient comes in with a lesion and goes out with the tooth restored. This is accomplished in one appointment. During this appointment, the dentist and his staff can demonstrate how comfortable they can make their patient by effective anesthesia, premedication, and proper application of the rubber dam. The patient can see the entire disciplined procedure of restoring the tooth with direct gold. When this is finished, the patient can test the finely adapted margins by lightly touching the explorer as the dentist carefully draws it across the margins. He can then tell the patient to notice how the gold appears almost as if it were painted into the tooth.

The porcelain inlay by the rapid firing technique is another procedure to effectively gain this time.[3,4] This is a procedure whereby the lesion can be restored with a porcelain inlay all in the same day or with two relatively short appointments. This is a highly effective way to motivate patients to our concern for health and esthetics.

Preventive control programs, doing periodontics and endodontics, as well as single restorative procedures, are other effective ways to gain time and build rapport with your patients.

Today, in 1971, I feel we should combine endodontics, periodontics, and restorative dentistry to form a treatment plan of total dentistry. They cannot

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be separated. If you can do your own endodontics and periodontics, along with your restorative dentistry, you have the chance to use this as motivation, and you should use it.

Another motivation factor is to develop a feeling of excellence in your patients. Often, you can do a pantographic tracing and by setting the gnathological instrument, the patient can see how you must discipline yourself to do these fine, intricate procedures. He can then appreciate this feeling of excellence you are trying to develop. We have a workbench next to the chair in the operatory where we do many of these things in front of the patient. As he watches, he will start asking questions, and this opens the door to educating and motivating him. Porcelain inlays are baked in an air-fired furnace on this workbench. When the patient can actually observe us making a porcelain inlay, he can appreciate the excellence of this fine procedure. The direct gold restoration is another very good way to develop this feeling and to gain the patient's confidence.

A good way to educate a patient to his "unknown needs" is to verbalize. This is a form of third party psychology. After the patient is properly draped, sedated, and the field isolated with the rubber dam, my assistant and I talk to each other while treating the patient. The relaxed patient is a captured audience who cannot talk, but can listen to every word. Our conversation may go like this, "Mrs. R., look at that pus. Can you smell it?" Oh! yes Dr., isn't that awful?" I may speak of "the thin shell of enamel" or "the amount of deep decay that is there." This paints a vivid picture in the patient's mind, and he becomes aware of his dental problems, as we are describing his "unknown needs.."

Another way to motivate patients to their "unknown needs" is through photography. A patient comes in with an initial complaint; we do that procedure and take pictures of it. The next time he comes in, we show him these pictures. Because of what he sees in these pictures, he will often accept our total treatment plan. One picture is worth a thousand words. In some instances, authoritative documentation may be required. Books, periodicals, and personally printed material can be used very effectively.

Self discipline is actually a way of life. We must discipline ourselves to good habits early in life, and maintain these habits throughout our lives. When we graduate from a professional school and go into private practice, we sometimes lose this discipline. It is ironic, but when we join a gold foil study club, we can often learn to develop these disciplines all over again.

One of the most evident and upsetting observations of the many applicants who take the State Board examinations in Florida, are the iatrogenic marks that some of these applicants are creating on adjacent teeth.[5] High speed instrumentation, in opening up the proximal-surface, will inadvertently nick the adjacent tooth. These burr marks then become areas that will later decay and create a further problem for the patient. This is not good for either the patient or for dentistry. Gold foil study clubs can help us review the discipline of cavity preparation and how teeth can be restored without injuring the adjacent teeth.

Technique is not transferable.[6] However, the ability to discipline yourself

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is transferable. By working in gold foil study clubs, we learn to discipline ourselves to fine techniques. This discipline carries over into all other aspects of dentistry. Therefore, you can say that you become a better dentist through gold foil.

Fundamental principles are absolute and inviolate. Techniques will change, but principles will not. We must know the fundamental principles of surgery, whether it is of hard or soft tissue. One of these principles is access. To see is to know, "Not to See Is to Guess." Through gold foil work, we learn easier and better ways to gain good access. We learn how to quickly and effectively utilize the rubber dam. We also learn how the rubber dam can help us, not only in restorative dentistry, but in periodontocs and endodontics as well. James Mark Prime lists 57 different reasons why we should use the rubber dam.[8] However, there is one main reason I feel we should use the rubber dam, and it is a selfish one. Today, the number one killer is cardiovascular disease, the heart attack. One of the main causes of heart attacks is stress. By using the rubber dam, you can create an atmosphere of relaxation in the office. If a patient is properly draped, sedated, and comfortable, the dentist and his assistant are relaxed. This creates an atmosphere of relaxation which is condusive to less stress and fatigue.

My philosophy is to keep my office staff at a minimum. One laboratory man, one assistant and one secretary. By keeping my staff to a minimum, I eliminate a lot of stress in the office, and more important, the whole staff can focus their attention on our patient. When the patient is "Mr. Big," he feels very important, and this, again, is good patient motivation.

How does gold foil help us in our appointment schedule? If you want to make money, you should have long appointments. This is perhaps one of the easiest ways to make money and still keep a relaxed atmosphere in your office. Our appointments range from a half day to a full day. The average appointment is a half day. During a long appointment, we may be developing a shade for a jacket crown, or soldering a fixed bridge. This takes a certain amount of laboratory time. It is during this time that a gold foil can be done. In this way, more dentistry can be accomplished during the long appointment. When we do total dentistry, we always try to save gold foils or porcelain inlays to do during this period of time.

How is gold foil utilized in total treatment planning? A simple Class III direct gold restoration on the proximal surface of a posterior tooth can be done in conjunction with a tooth preparation on an adjacent tooth. For example, when you prepare the distal surface of a second bicuspid for a casting, you create good access to the mesial surface of the first molar. If there is a carious lesion on the mesial surface of this tooth, you now have the access to prepare and condense a simple Class III direct gold restoration. It is important that this lesion be treated immediately, since you may not have access this good at any other time. The direct gold restoration, restoring the proximal surface of the molar, is inconspicuous or invisible when the bicuspid is restored. The simple Class III direct gold restoration preserves the integrity and strength of the mesial marginal ridge of the tooth. When you are preparing a tooth for a casting and have to destroy all or most

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of the proximal contour of this tooth, it is very important to preserve, when possible, the proximal contour of the adjacent tooth. If this surface and its contour are kept intact, you have a positive guide to restoring the proximal contour of the tooth that will receive the casting. If this contour is correct and the casting is accurate and seated properly on the preparation in good occlusion, the supporting tissues will readily accept this casting. An understanding of the principles of periodontics is a prerequisite to operative dentistry. We should not attempt to restore a tooth unless we can produce a restoration that is conducive to a biological acceptance of the restoration by the periodontal tissues.

The six year molars can be treated with simple Class III direct gold restorations when the second deciduous molars have exfoliated. If the parent is warned to bring the child into the office when these deciduous molars are lost, this procedure can be accomplished with good access. The second bicuspid then erupts into place, giving the child a six year molar that has the mesial surface restored as conservatively as possible, with a material that has a history of lasting results and the maximum in esthetics.

Every practicing dentist has seen posterior teeth where the overall outline form is entirely too wide. I have observed over 1500 applicants who have taken the Florida State Board examinations in the past three years. A large number of these applicants open the occlusal portion of a tooth with a burr that is too wide. An example would be a #57 or #58 crosscut fissure burr. Quite often, this leaves an outline form that is over-extended. A large, over-extended amalgam simply will not support an occlusion. The amalgam wears quicker than the enamel and this can result in an imbalance of the occluding surfaces. There seems to be a tendency to over-cut teeth that are to be restored with amalgam, even when they can be restored conservatively with minimum outline forms giving lasting results.[9] This could possibly relate back to the monetary compensation for this service. Isn't it better to restore the incipient occlusal lesion with gold foil right in the beginning and preserve as much enamel as possible, keeping the occluding contacts on enamel? When a tooth is restored with gold foil, the patient appreciates that this is a gold restoration and does not mind spending the extra money that is required to get this service.

Dentists recognize and respect quality treatment. Therefore, if a patient has to move to a different location and another dentist sees this patient, he will recognize the quality treatment you have given your patient and try to maintain this same standard of excellence. This is another reason I like to use gold foil when restoring teeth with occlusal decay.

Gold foil should be used to restore the incipient interproximal lesions of the teenage patient. Anterior teeth of these patients lend themselves to easy preparation. Good access to this lesion can be easily achieved. With a small, round burr, #½ or a #1, mounted in a straight handpiece, the decay can be removed. The approach is from the labial. The outline form is limited to only the removal of the decay. Retention and resistance form is gained by a retentive area in the incisal and one in the gingival. The cavosurface margin is beveled. The toilet of the cavity preparation is accomplished and

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it is ready to receive the direct gold restoration. This is a simplified preparation that takes a small amount of time to accomplish, but oh! what a service you can render to that child. Kids definitely need gold foil. With conservative dentistry and a properly utilized preventive control program, there is a very good possibliity they will be able to maintain these teeth and surrounding tissues in a good state of health for the rest of their life. *This is service.*

Of course, all patients, whether young or old, do not always have small, incipient lesions to restore on their anterior teeth. Some have old restorations that need to be replaced. Many times these lesions can be restored with direct gold if enough retention can be developed and if the labial outline form lends itself to an esthetic placement of the material.

I feel it is extremely important in todays dentistry to be conscious of esthetics in your treatment plan and only place gold where it is indicated. If a lesion is on the mesial surface of an anterior tooth, and is quite conspicuous when the patient speaks or smiles, this lesion should be restored with a porcelain inlay. In todays dentistry, porcelain inlays can be fired on refractory dies [10] [11] [12] or by the rapid firing technique. I prefer the latter because the dentist can do this technique in front of the patient. This is a great motivational procedure for a patient to watch the inlay being fired and see it seated into the cavity preparation. When he can't tell the difference between tooth structure and procelain, he is truly impressed with the operator's abilities and his disciplines toward achieving excellence. On the strength of one porcelain inlay or one gold foil, I have been able to sell my patient on his total treatment plan. This is extremely encouraging and rewarding, not only monetarily, but more important, from a sense of achievement and service to your patient.

The cervical lesion that needs to be restored, whether it is decay or erosion, is an indicated area to use gold or porcelain. If the lesion shows when the patient smiles, porcelain is the material of choice. This is especially true of maxillary anterior and bicuspid teeth on patients who have a short upper lip. Look at the smile line of your patient and make your decision to use either gold or porcelain in your treatment plan. If the cervical area is not noticeable, or if the incisal outline form can be made to blend in with the smile line of your patient, gold foil is definitely indicated.

Full mouth reconstruction is nothing more than a monument to poor and inadequate dentistry. If teeth are restored properly in the beginning, utilizing conservative outline forms and lasting materials, and the patient placed on a good preventive program, most reconstruction would not be necessary. Sad as it is, there are still many patients who require a complete rebuilding treatment plan. Whether patients are being rebuilt with a functional generated path technique, or by the use of pantographic tracings and the setting of a fully adjustable articulator, it is a good idea to preserve, whenever possible, the lingual contour and the position of the incisal edge of the anterior teeth. Again, direct gold restorations and porcelain inlays can be effectively utilized in a treatment plan to achieve this purpose. If the lesions are too large and the remaining tooth structure too weak to support this type restoration, porcelain or porcelain to gold jackets should definitely be used. When possible, one should prepare and restore every other anterior tooth, then prepare

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and restore the adjacent teeth. By restoring the teeth this way, you can preserve the lingual concavities and maintain the incisal edge at the proper position labiolingually. This will also help to maintain the anterior incisal guidance that has already proven to be physiologically acceptable to that patient. This cannot be done on every patient; however, whenever possible, this most important anterior guidance should be preserved.

The cuspids are the most difficult teeth in the arch to restore with porcelain jacket crowns or porcelain veneered gold crowns and still achieve good esthetics. They always appear too large and bulky even though they may be restored with a smaller contour than their original size. It is almost impossible to restore a cuspid, and still have it look as natural as it was before it was cut down. If the labial enamel can be preserved by restoring this tooth with gold foils or porcelain inlays, or both, a better esthetic result will be achieved. When at all possible, preserve the labial surface of these teeth, rather than utilize full coverage. The average full crown has a life span of 10.3 years, according to a recent study.[13] Our dental work doesn't last as long as we like to think. Therefore, it is important for us to be cognizant of the better ways of doing fixed partial prosthetics. Wouldn't it be even better if we could avoid doing any full crowns simply by using gold foil for these incipient lesions in the early stages of adulthood?

There are some Class II foils that can be effectively utilized in a treatment plan of total dentistry. In some cases, better esthetics can be achieved by restoring the first bicuspids with Class II foils rather than by restoring them with a cast gold restoration.

Today, in our 1971 dentistry, we must consider esthetics; we must consider conservatism; we must preserve the enamel when at all possible, and we must think of the mouth as a total masticatory mechanism, where the lower arch functions properly and in harmony with the upper arch.

The reason we are in dentistry is to be of service to our patient. In order to be of service and do an effective total treatment plan that will help our patient, we must be able to motivate our patient to accept our philosophy and treatment plan to total dentistry. John Keating once said, "A thing of beauty is a joy forever, its loveliness always increases. No, no, it can never grow into nothingness."

God has given us many beautiful things. He has given us beautiful people and beautiful smiles. He has challenged us as a profession, to maintain this beauty and preserve these smiles for a lifetime.

Today — in the dawning of the age of Aquarius, October 8, 1971, I ask you . . . Gold foil, can we afford to do without it?

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Clifford H. Miller, D.D.S.

G. V. Black's class III cavity preparation

Dr. G. V. Black

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G. V. Black is regarded as the originator of a disciplined approach to cavity design and preparation and as such it is only natural that his concepts would be utilized as prototypes from which the current modifications in design and approach would emanate. In an effort to obtain the most unadulterated version of the Black Design for Class III preparations, his original lecture notes on the subject were borrowed from the G. V. Black library collection at Northwestern University Dental School. Many of these were written in Black's own hand and the content and method of presentation have not been altered for this publication. Following, then, are the reproduced lectures of Dr. G. V. Black which relate to the Class III Preparation.

General Principles Governing Excavating

Before going into the preparation of particular or individual cavities, it is well to discuss the general principles to be observed in excavating cavities for filling. That is, such principles of mechanics and of mechanical procedure as govern in excavating cavities in general.

First — It should be understood that there are general principles governing the forms of cavities.

Second — There is a certain definite order of procedure that is best and that is fairly universal.

Cavities in General

If these general principles are well fixed in the mind, the special steps in individual cavities will be more easily learned.

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Presented at the Annual Meeting of AAGFO at the University of Pennsylvania, October 8, 1971.

These general principles may be stated in this order and represent both forms to be attained and the order of its attainment.

First — Outline form
Second — Resistance form
Third — Retention form
Fourth — Convenience form
Fifth — Removal of remaining decay
Sixth — Beveling margins and finishing or the toilet of the cavity

Outline form represents the cavity margins. This is to be attained first of all, not absolutely and unchangeably but in the main.

Resistance form refers to the seat of the filling — that portion of the cavity which shall support the stress that may come upon the filling in mastication. This should always be flat or nearly so and at right angles to the line of stress. It is the second item looked to in preparing cavities.

Retention form is that shape given to some portions of every cavity that will prevent the filling from being displaced. This is naturally looked to as soon as the form of the cavity and the seat for the filling have been cut and should always be made ample.

Convenience form although placed fourth on the list, is to be continually in the mind throughout the excavation. It has reference to the peculiarities of form to be attained that will render the insertion of the filling easy and certain. In cutting the outline or laying the marginal lines, reference should be had to ease of introducing the gold and condensing it and more cutting done here or less there as will best accommodate the building of the filling.

Removal of remaining decay. Removal of decay should be the last thing before making the toilet of the cavity — and this for several reasons. First, if the cavity is not deep, the decay will probably all be removed in getting outline form, the resistance form and retention form. Second, if the decay is very deep the removal of the remaining portions may expose the pulp — and this should never occur until the cavity is ready to proceed with the treatment of our exposed pulp.

The finishing-beveling of margins and the toilet of the cavity.

When the form of the cavity has been obtained, it is in a rough state — more or less. Then it is to be smoothed up. The lines of the margins are straightened up or curves are trimmed to good and definite lines and all parts re-examined. Then the enamel margins are beveled to remove any roughness and to see to it that the outer ends of the enamel rods are removed, or so cut that rods will not fall out during the filling or afterward. All of this last work is to be done with the dam in place, with the cavity dry. Then the cavity is swept with absorbent cotton till every vestige of chips and dust are removed.

No fluid of any sort is to be placed in the cavity after the last finishing is begun, no antiseptics nor anything whatever of that nature.

A filling should always be placed against perfectly fresh cut walls. I have strong feeling that a really good filling cannot be made against walls that have been wet with any substance whatever after the last cutting has been

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done. I do not risk even alcohol or ether — and these would be best for final washing.

Now we approach the proximate surface of the incisors. There is perhaps more attention paid to the appearance of these teeth than any others and filling cavities in these so that they will give a good appearance becomes of the greatest importance. Yet we are not to sacrifice strength here for appearance; we are not to sacrifice durability for appearance. If our cavities are large we must so manipulate them, we must so form our fillings, that they will look well, even though much gold may show. Here it is gold and nothing but gold for permanent fillings; there is nothing else that will do. To put amalgam into such a position is simply abominable and no other filling materials give a promise of permanency, so that it is gold and nothing but gold. We must prepare our cavities for gold. Of course we have a large use here for temporary work, which we will speak of more in detail later.

In opening these cavities the smaller instruments of the set — the ordinarys — will generally be used, using first, if the cavity be small, hoe 8-3-6 generally. If the cavity is somewhat larger, hoe 12-8-12 or 12-5-6. The rule should be to make the opening from the labial. I will say that this rule has been the subject of a great deal of controversy among dentists — shall we open these from the labial or shall we open them from the lingual? Very many preferring to open these cavities from the lingual. I should make few exceptions to the rule of opening them from the labial. I say, open them from the labial for the reason that we gain more direct access to our cavity, that we see our cavity better, that we obtain more direct access with pluggers, and withall it is my opinion that we will do our filling better if we make our opening from the labial, where we get more direct access and where we see all parts of our cavity better and more perfectly. The objection to opening from the labial is that in so doing we expose the filling more to view. The fact that the filling is exposed more to view is not without its importance, for it is important that we hide these fillings as much as practicable, but not to the detriment of the filling. The filling must be made good first. The provision should first be made for making the filling good. If in making the filling good we can reduce the amount of filling exposed to view, all is well, but open these very generally from the labial, even though it does expose the filling somewhat more to view, for the reason that we gain the access to our cavity more direct, we see our work better and we can perform the operation of filling the tooth better. In opening the cavity, if it is small, you will find it of some advantage to separate first, but the separation of the tooth is for the purpose of finishing the filling rather than for excavating. Yet in the incisors it sometimes becomes important that we make the separation at the beginning of the excavation, or before beginning the excavation, as a convenience in excavating, and for the further reason that the spring of the instrument will be carrying them still further apart, and we will get a broader separation for the purpose of finishing. Then take the hoe, angle 6 will usually be best, whether the 12 in breadth or the 8 in breadth will depend something upon the size of the cavity. In a small cavity you will use the smaller instrument, even to 5 in breadth in some cases, and beginning

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at the labial you will be able to split off any of the enamel that is undermined by decay; a little pressure in just the right direction with a sharp instrument will chip the enamel away from the labial and expose the decay.

This splitting away should continue until all overhanging enamel is removed toward the incisal portion and toward the gingival, but it is not necessary to remove all overhanging enamel upon the labial in large cavities. In the small cavities, however, remove all overhanging enamel in every direction. Now, after the overhanging enamel is removed and the decay well exposed from the labial, you can usually with the same instrument remove the enamel and cut down the gingival wall. The hatchet 12-5-6 will generally come in play or the hatchet 8-3-6. You will find the instrument very well shaped to cut toward the lingual and shave down the gingival wall and make it flat from mesial to distal; also it will do very much toward flattening this wall from labial to lingual. You will find that you can make the gingival wall perfectly flat, and by reason of the curvature of the gingival line you will have more enamel between it and the cavity at the labial and the lingual, and less enamel midway from labial to lingual, so that you will have strong pillars of enamel at the lingual and strong pillars of enamel at the labial against which to form your abutments, as it were, for the ancorage of the filling. Hence we will cut the gingival wall directly across the long axis of the tooth from labial to lingual. When this is done you will give your attention to the lingual wall. In small cavities you can generally cut this wall first from the labial through the cavity, and this same instrument, hatchet 12-5-6, or hatchet 8-3-6, will generally be the suitable instrument for trimming down that wall. The further operation upon that wall will depend largely upon the amount of decay. If the decay is but slight, if the cavity is small, you will cut that wall to the mesio-lingual angle, not past, or only just past the crest of the angle. Give your attention next to the incisal angle of the cavity. The incisal angle will be best cut out with the two instruments of the angle of 28. These two instruments are made especially for this one position, and excavating toward the incisal in incisal cavities. There is no other position in the mouth in which these instruments are used. In the large cavities excavate with the larger instrument; in smaller cavities with the smaller one, you will find that you can easily excavate toward the incisal, remove all decay, and cut such grooves in the angle as may be necessary.

Now, we will turn for a moment to retention form. The retention form in these cavities will depend somewhat upon the size of the cavity, and yet it is similar in all incisor proximate cavities. The retention forms made if we prepare and fill from the labial are somewhat different from the retention forms we would make if we prepare and fill from the lingual. For retention in these cavities make a pit with an inverted cone bur in a direction to the lingual in the linguo-gingival angle, doing this from the labial. With your bur, a small bur, you can draw along the lingual wall close against the axial wall, cutting mostly into the lingual wall, but partly into the axial also, forming a groove. Then with the same bur draw a groove a short distance, and only a short distance toward the labial, cutting into the gingival wall close along against the axial wall. Do the same in the labio-gingival angle. Often you

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may work from the lingual in cutting this pit to the labial and in grooving the labial wall close against the axial. These grooves are not to be carried far in either direction, and above all things make your gingival wall flat from mesial to distal, or square across the long axis of the tooth, not sloped outward, not sloped inward in the central parts of the gingival wall. Here is the point of weakness, the point where you are most liable to break down your enamel in packing your filling, and the point that is most difficult to see in the making of your filling; most difficult to correct an error in the making of your filling. Leave that flat and strong, beveling your marginal edge of the enamel as little as you may think, in the position that you have, will cut parallel with the enamel rods, then only a slight bevel, smoothing it very nicely. Now, when this is done you have two points of fairly strong anchorage. Not merely pits, mind you, but beginning with a pit extend a groove in each direction for a distance so that you have a broader surface, a mass of material that will not be easily broken away. A mere pit is not good as an anchorage, even where we have the least of pressure in mastication coming upon our filling. Toward the incisal angle cut another groove that will pass around this portion of the cavity. Now, this groove should not be cut deep, it should be shallow. Indeed, if you cut precisely square across the long axis of the tooth it is enough. You do not increase the strength of your anchorage by increasing the depth of your groove. In order for the filling to move outward it is necessary that the whole thing turn togeteher, and a very little depth is sufficient. If you cut deep you weaken your angle without strenthening your anchorage.

Now, this cutting is done with the hatchet of the angle of 28 almost entirely. In some instances you can place a bur, a very small one. The lips get in the way, however, the nose or the face of the patient gets in the way and often you cannot reach that portion of the cavity with a bur. But with the hatchet angle 28 you can always reach it and always cut if you have your instrument sharp.

Now, in case you choose in a cavity of this kind to work from the lingual, you would cut more from the lingual, and less from the labial. You would make these anchorages the same, that is, the gingival anchorages, the labio-gingival and the gingivo-lingual anchorages should be made the same, but instead of grooving to the incisal for the anchorage in that portion you would groove the labial wall to the incisal angle, not around it. Then you would make your filling in that portion of the cavity by hand pressure, not being able to reach it with mallet pressure.

Now, in making your anchorages it is competent for you to round your axial wall from mesial to distal, protecting your pulp by cutting little in the direction of the pulp in the central region of the axial wall and rounding it to the labial and to the lingual to make a greater depth for that anchorage in that locality.

After going over this, cutting the angles of the cut edge of the enamel right and beveling them right, we will find that our cavity is fully excavated as a rule. We will have avoided, however, cutting toward the pulp along the central portion of the axial wall.

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I wish to return for a moment to the rubber dam, to speak especially of the time at which it should be placed on the tooth during the operation. And in this I will perhaps speak a little indefinitely and yet perhaps sufficiently definite for you to follow my idea.

I would not always put the rubber dam on at the beginning of an operation, that is, at the beginning of the excavation. To most patients the presence of the rubber dam in the mouth is disagreeable, and especially does it become very disagreeable when it is retained in the mouth very long. It should be an object to avoid keeping the rubber dam on the teeth for a long time, on account of its disagreeable nature, and on account of the fact that the mouth is necessarily propped open during the whole time. If, in beginning the opening of a cavity, I find that I can work easily, that the saliva is not very troublesome, I should do the major part of the excavating before placing the rubber dam. I should state that as a general rule. If, however, it appears in the progress of the excavating that the saliva is giving considerable trouble, interfering badly with the view of the work, I should at once stop and put the rubber dam in place. We cannot afford to be handicapped in that way during the operation of excavation. It is pretty generally the case in operations upon teeth of the lower jaw that we will need the rubber dam placed almost immediately after the first breaking away of overhanging enamel; that is, just as soon as we need to see into the cavity we will need the rubber dam in place. It often happens, however, that in operating upon the teeth of the upper jaw, particularly the bicuspids and molars, that we may do the major part of our excavation just about as well without the rubber dam as with it. But in every case the rubber dam should be placed before the completion of the excavation. We should never think of trimming our margins, in preparing definitely for the reception of our fillings, without the rubber dam in place, for it is necessary that the walls as finished by this last cutting be kept perfectly dry, unsullied by the touch of anything, except the necessary touch of the steel instrument.

It occasionally happens that we have patients who are particularly sensitive to the placing of the rubber dam. They are nauseated by it. I have never found this sufficient to bar the use of the rubber dam. I have had a number of patients with whom I had to be firm, with whom I had to labor for some time to bring them to bear the rubber dam. They would be nauseated particularly in placing it in the back part of the mouth, and threaten very ugly results, threaten to lose their breakfast or their dinner, but a little persistence has been uniformly successful, and if we are successful once with this patient, we generally have less trouble afterward. They will learn that by a little persistence and effort upon their part that they will succeed in bearing with the rubber dam, succeed in keeping down that which proposes to rise, and go along very well.

Now, I will pass to the subject of separating teeth. When I began the practice of dentistry, the only method of separating teeth was to use the separating file. Now, if my notion is carried, there will not be a separating file in any instrument case in this school. It is an abandoned instrument. It is a back number. We have no use today for a separating file. It has

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been of more damage to our patients than any other instrument we have ever used. In the days of noncohesive gold, however, we could not do better, perhaps, but since we have cohesive gold, and are able to contour the teeth, and have become enabled to separate them sufficiently to obtain working space by other means, we should abandon completely and finally the use of separating files. If we use it in finishing, it gives us a flat surface just where we should have a rounded surface to make contact with the next tooth, and hence it is a dangerous instrument to the health of the teeth and of the gum. The first method of separating teeth by forcing them apart was by driving or by pressing wooden wedges between them. This quickly attained to heroic proportions. I remember once in the latter part of the sixties — Dr. Peebles, long since passed away, was asked if he waited for the capillary attraction of the moisture of the mouth to expand his wedge and drive the teeth apart. He said; "No; after I drive the wedge, I don't think capillary attraction will affect it." We used to drive these wedges pretty tight. We used to require a very considerable separation of the teeth. That is not necessary now. We may still use a wedge, if we use it with discretion, if we use it cautiously, but there are many objections to the use of a wedge, and especially to DRIVING a wedge, and one of the prominent ones is that it hurts, and the next one is that we crush the interproximate gum tissues.

Following the use of the wedges came the use of cotton, ligatures, and so forth, for wedging teeth. By forcing cotton between the contact points, and tying it in. After having passed a ligature between the teeth, then forced cotton between the contact points — then tie the ligature over the cotton and in that way wedge the teeth apart quite handsomely, particularly teeth that have prominent contact points. Often, we may press the cotton into one of the cavities of decay so tightly as to wedge the teeth. I have generally found that a difficult method of wedging, yet some operators succeed in gaining sufficient space that way, either with or without the ligature, and seem to get along quite comfortably. That plan of wedge causes very little soreness in the teeth. Of course, we have to wait a day or so for the movement of the teeth. The next plan, and one much in vogue is wedging with rubber. There have been many kinds of strips of rubber manufactured and sold for that purpose, but perhaps there is nothing better than to begin with a piece of very heavy rubber dam, cut in strips, draw it between the contact points, and let it go, and then with your scissors cut it closely, having the width such that it will be well between the contact points and not so much toward the occlusal, as to be in the way; nor so much to the gingival so as to destroy the gum tissue, but remaining fixed between the contact points. That will wedge the teeth apart quite rapidly. It will also make the teeth very sore. It is a painful method of wedging, and yet is so successful that many of us have used it considerably. I will have more to say about that presently, or in my next lecture — that is the use of the rubber, in special cases. I want to say, however, before passing on, that if you use the rubber, you must be especially on your guard as to allowing it to slip into this V shaped portion of the inter-proximate space, for if it slips into that V shaped portion, the whole force of the rubber will be expanded upon the gum tissue

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instead of in separating the teeth, and you will have an injured gum septum. The best rubber for the purpose is strips cut from the ordinary rubber bands found in the market — just the ordinary rubber bands for holding papers. I have not had any strips manufactured for this purpose that were any better than these bands. You may use any kind, from the thinnest to the thickest for the different operations. Here are some that are very thick and strong. It is very cheap. One of these bands ought to last you for the purpose so long as the rubber will keep good. You can cut your slips from it and use it all up.

Mechanical separators have come much in vogue in recent years, and of these there are many. I hold in my hand what is known as the Ivory Separator. Now this will separate teeth rapidly and effectually — it is a steel wedge driven between the teeth by a screw. I don't know that it has any special advantage over the wedge driven with a mallet, except that the patient is relieved of the pain produced by the blow, an actual and very gratifying relief, so that this separator is not as damaging to the patient as the driving of a wooden wedge. We have, however, the same objection to it; that is, its tendency to slip against, and destroy the gingivae. We also have the same objection, that it hurts, and the wedges remain between the surfaces to be operated upon and hide somewhat our gingival margin in many cases, and prevent us from finishing a filling as we would like to do. This bow should be propped up with gutta percha in such a way as to prevent the slipping of the wedges against the gum tissue. It is not a convenient wedge. It is very much in the way in operating. It is large and clumsy, and, therefore, I don't like it. There is another made upon the same principle as this, I forget the name of it, it has a single steel bow. Well, it is worse than this one. More objectionable than this one, for you cannot in any way operate that so as to prevent the wedges infringing upon the gum tissue. I may say, however, in passing, that there is no mechanical device yet devised, to which there are not serious objections. I dislike this one, however, very much, both because of its tendency to destroy the inter-proximate gum tissue, because it is so much in the way in operating. It is large and very objectionable. The best mechanical device yet introduced is the two-bow Separator, known as the Perry. There is one very serious objection to the Perry Separator, and that is that it is very expensive $3.50 each, and there are six in the set.

Editor's Note: *The foregoing article has been published without editorial changes, since it was presented by Dr. Miller as original lecture notes of Dr. G. V. Black. This also explains the absence of a bibliography which would only reference his own material.*

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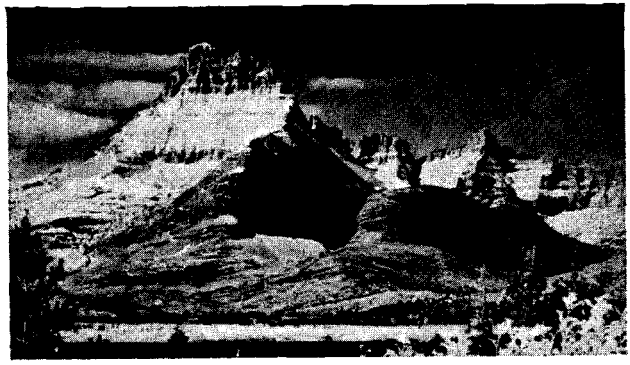

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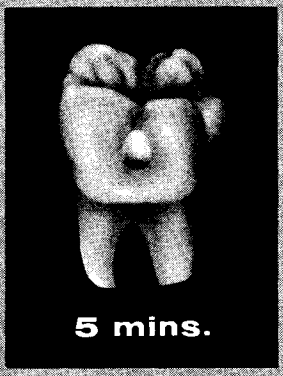

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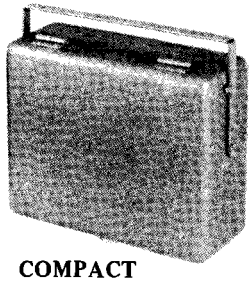

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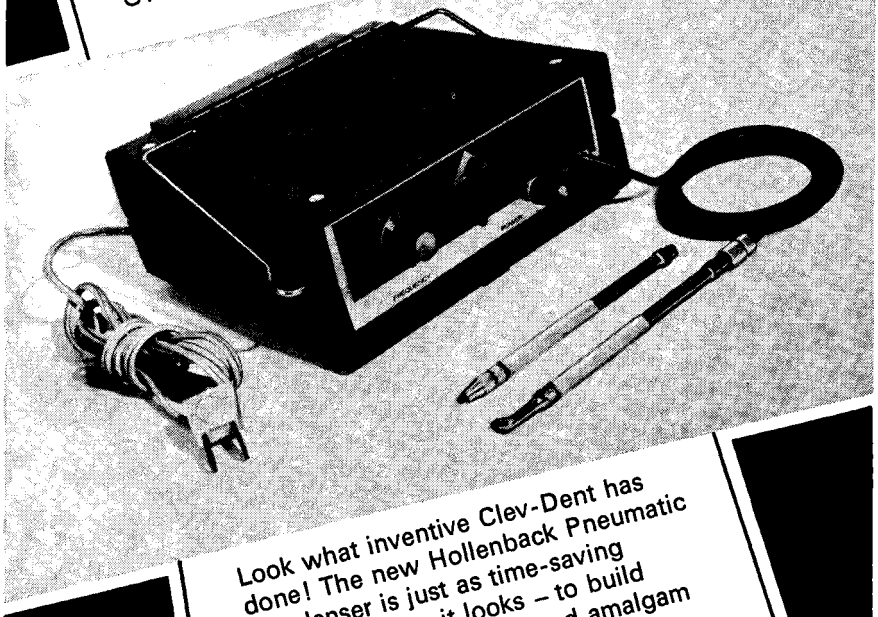

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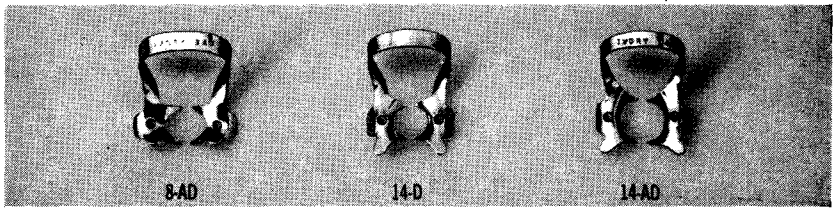

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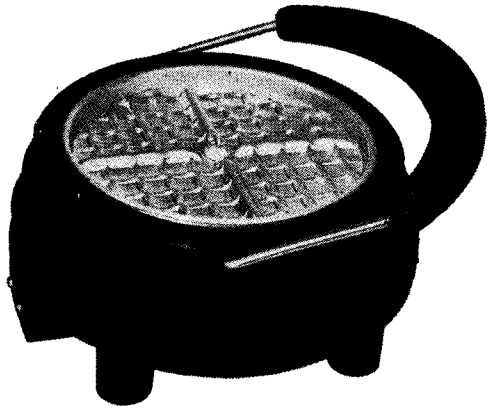

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